

Baseline Ecotoxicity Study

Surface Water

DRBC TAC Meeting
May 7, 2012

A. Ronald MacGillivray, Ph.D.
Modeling, Monitoring & Assessment Branch
Delaware River Basin Commission

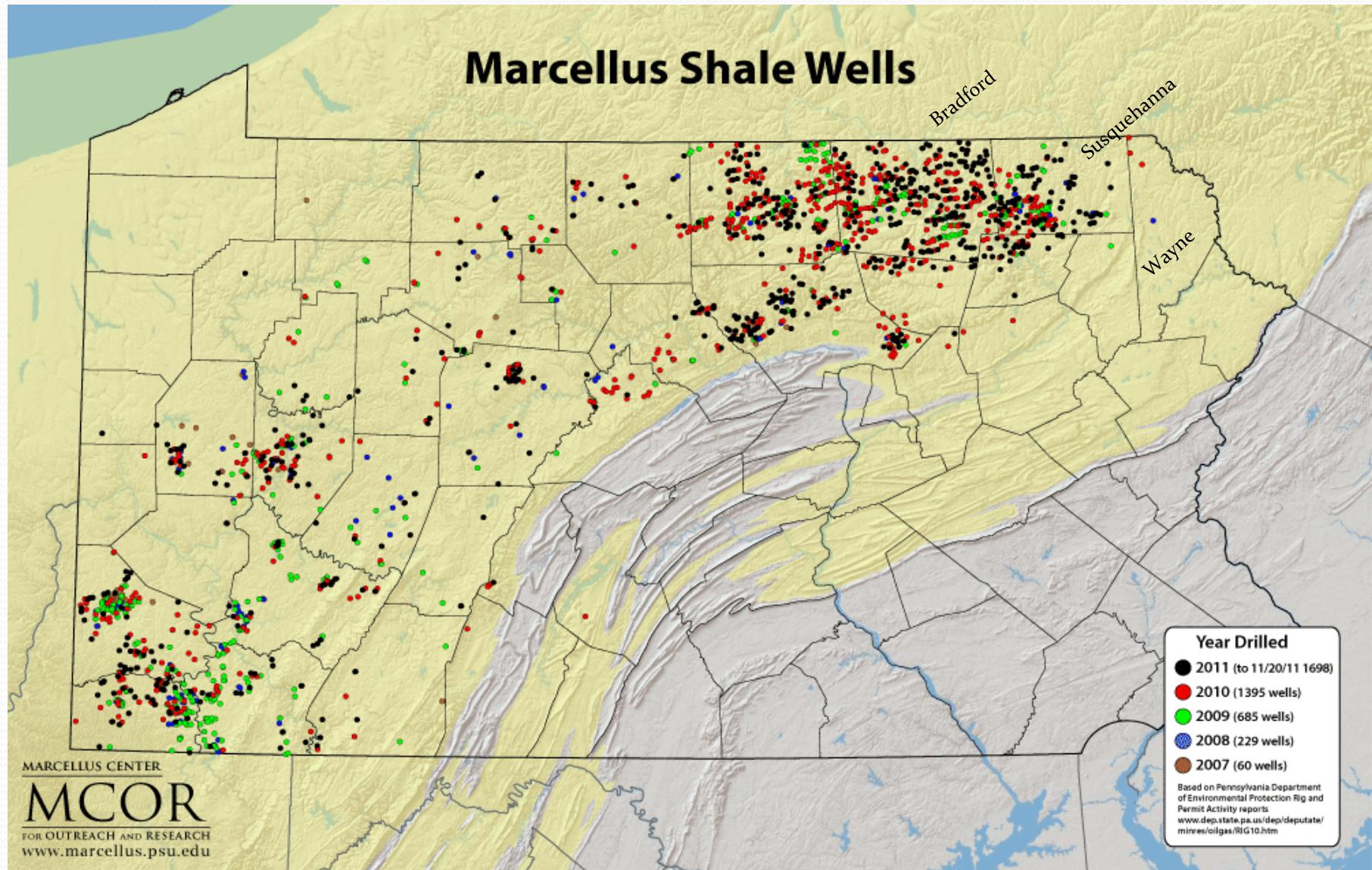


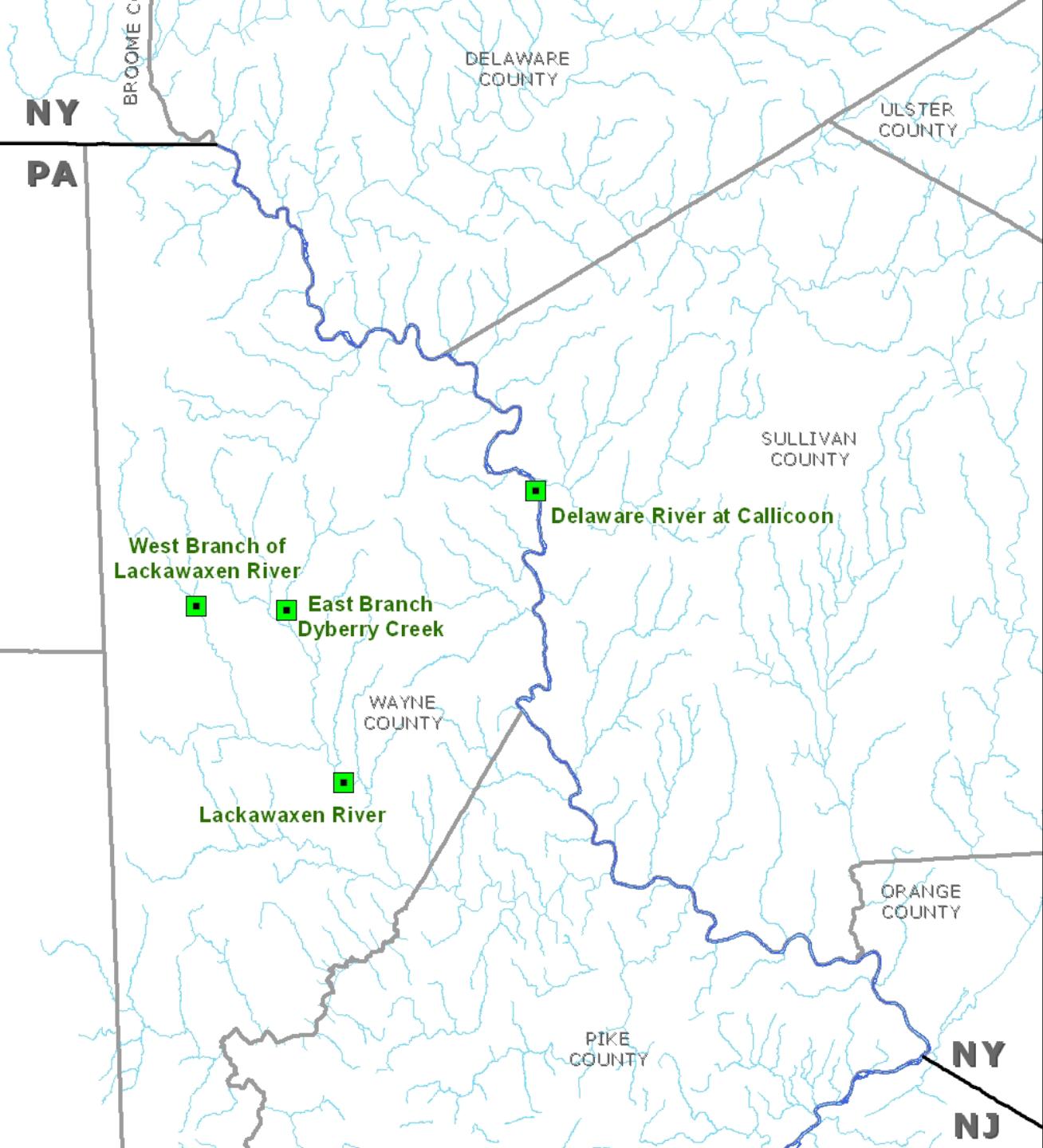


Marcellus Shale and Special Protection Waters

**36% (4,937 mi²)
of the Delaware
Basin is underlain
by the Marcellus
Shale**

Drilling Activity from 2007- Nov 2011





Legend

■ Toxicity Sites



0 2.5 5 10
Miles

Ambient Monitoring



Ambient Monitoring



Ambient Monitoring



HOBO-U24

Conductivity / Temperature Logger

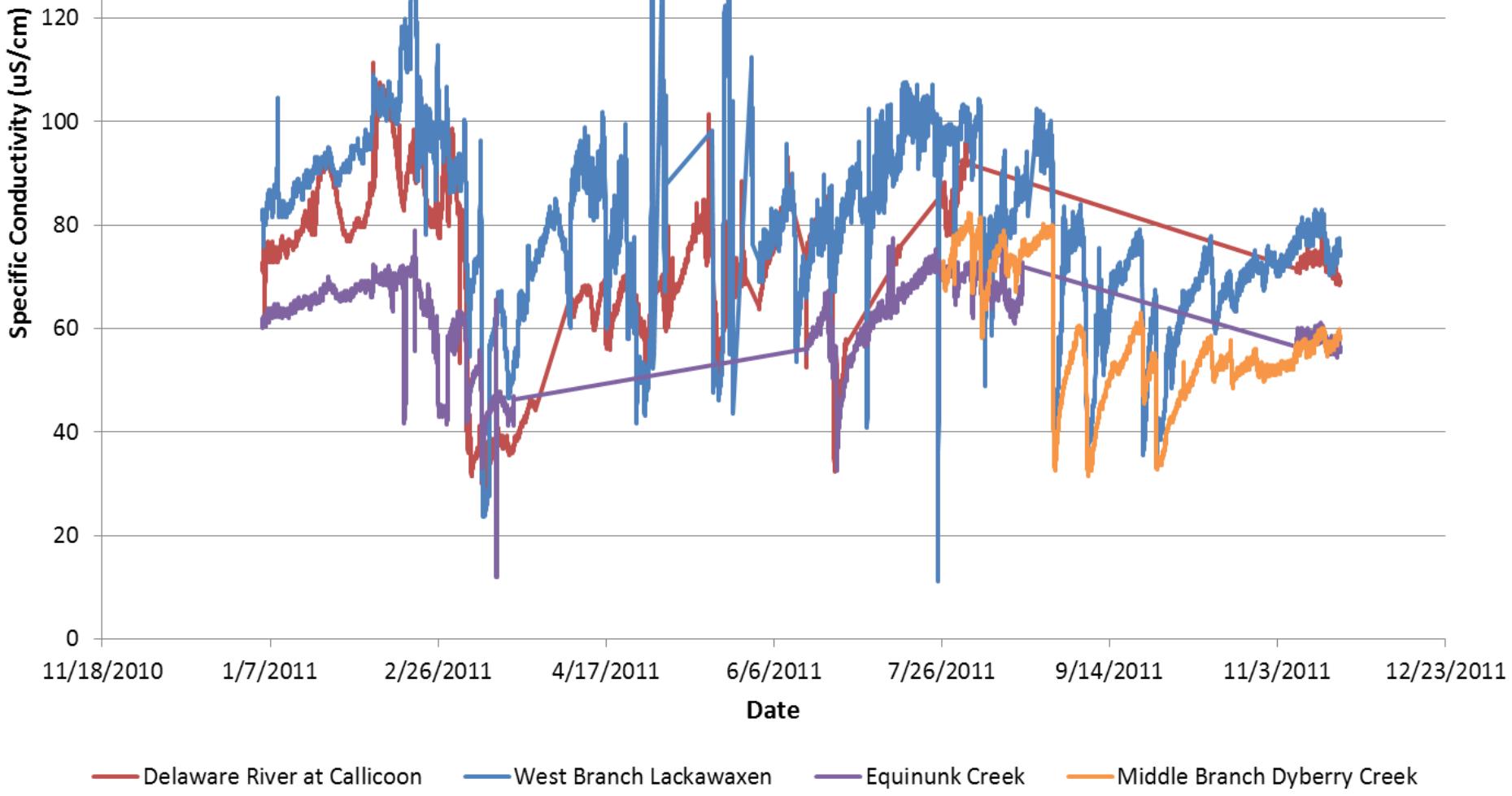


HOBO Results

Results Uncorrected

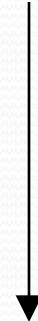
	Delaware River at Callicoon	West Branch Lackawaxen	Equinunk Creek	Middle Branch Dyberry Creek
75th Percentile	81.3	91	67.7	68.5
Median	73.7	79.1	63	54.7
25th Percentile	65.3	69.8	57.6	51.4

Compare with typical concentration of flow-back from 19 PA gas wells = 228,494. umhos/cm



Ranking of Constituents in Flowback Water by Mean Water Concentration

<u>Parameter Group</u>	<u>Results (mg/L)</u>
Total Dissolved Solids mg/L 10 SM18 2540 C	81,627.02
Chloride mg/L 1 MCAWW 300.0A	49,472.68
Hardness, as CaCO ₃ mg/L 5 SM20 2340C	24,787.62
Sodium-DIIS ug/L 5000 SW846 6010B	21,710.21
Sodium ug/L 5000 SW846 6010B	20,197.76
Calcium-DIIS ug/L 5000 SW846 6010B	6,949.16
Chemical Oxygen Demand (COD) mg/L 10 MCAWW 410.4	6,686.42
Calcium ug/L 5000 SW846 6010B	6,518.05
Strontium-DIIS ug/L 50 SW846 6010B	1,510.51
Strontium ug/L 50 SW846 6010B	1,433.30
Barium-DIIS ug/L 200 SW846 6010B	1,156.48
Barium ug/L 200 SW846 6010B	1,149.11
Magnesium-DIIS ug/L 5000 SW846 6010B	586.62
Biochemical Oxygen Demand mg/L 2 SM18 5210 B	553.74
Magnesium ug/L 5000 SW846 6010B	548.72
Bromide mg/L 1 MCAWW 300.0A	507.77
Potassium-DIIS ug/L 5000 SW846 6010B	483.34
Potassium ug/L 5000 SW846 6010B	461.04
Total Suspended Solids mg/L 4 SM20 2540D	338.70
Dissolved Organic Carbon mg/L -- SM20 5310B	316.98
TOC mg/L 1 SM20 5310B	297.40
Acidity mg/L 5 SM20 2310B (4a)	250.66
Total Alkalinity mg/L 5 SM18 2320 B	131.50
Sulfate mg/L 1 MCAWW 300.0A	104.56



DRBC/Stroud Mayfly Toxicity Testing

- The headwaters of the Delaware River Basin are typically soft (hardness - 20 mg/l) with low ionic strength (spec. conductivity – 60 umhos/cm). These water quality characteristics may influence the effects of pollutants.
- To evaluate the use of alternative toxicity test species and the impact of these waters on the response of standard toxicity test species, the Commission is working with the Stroud Water Research Center .



Centroptilum triangulifer
Photo from: www.discoverlife.org

DRBC/Stroud Mayfly Toxicity Testing

- Project tasks (2012) include:
 - Collecting pre-drilling alteration surface water samples in upper basin tributaries;
 - Collecting representative samples of natural gas drilling flowback/production water;
 - Sample analysis for physical-chemical parameters;
 - Toxicity testing using standard whole effluent toxicity/receiving water test methods (*Pimephales promelas*, *Ceriodaphnia dubia*, and *Pseudokirchneriella subcapitata*)
 - Toxicity testing using alternative test procedures using native mayflies (*Centroptilum triangulifer*, *Procloeon rivulare* and *Pseudocloeon frondale*)

Partnerships

- DRBC
- U.S. Geological Survey
- National Park Service
- PADEP
- NYSDEC
- Stroud Water Research Center
- Dickinson University
- Delaware Riverkeeper Network
- Academy of Natural Sciences
- Smithsonian Institution
- U.S. EPA; Haas Foundation (funders)
- QC Laboratories Inc.; NJDOH Lab; EcoAnalysts Inc. (lab support)



Questions?

Technical / Scientific Contact Information:

General Monitoring/Modeling: Thomas.Fikslin@drbc.state.nj.us

HOBO, Other Continuous: John.Yagecic@drbc.state.nj.us

Scenic Rivers Monitoring: Robert.Limbeck@drbc.state.nj.us

Biological/Habitat Monitoring: Robert Limbeck or Erik.Silldorff@drbc.state.nj.us

Toxicity Monitoring: Ronald.MacGillivray@drbc.state.nj.us

Groundwater Monitoring: Ronald.MacGillivray@drbc.state.nj.us

Natural Gas Economic Projections: Gregory.Cavallo@drbc.state.nj.us

Watershed Modeling: Namsoo.Suk@drbc.state.nj.us

website <http://www.drbc.net>

Tel. 609-883-9500



Delaware River Basin Commission
DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA